Name _____

Pd. _____ Date: _____

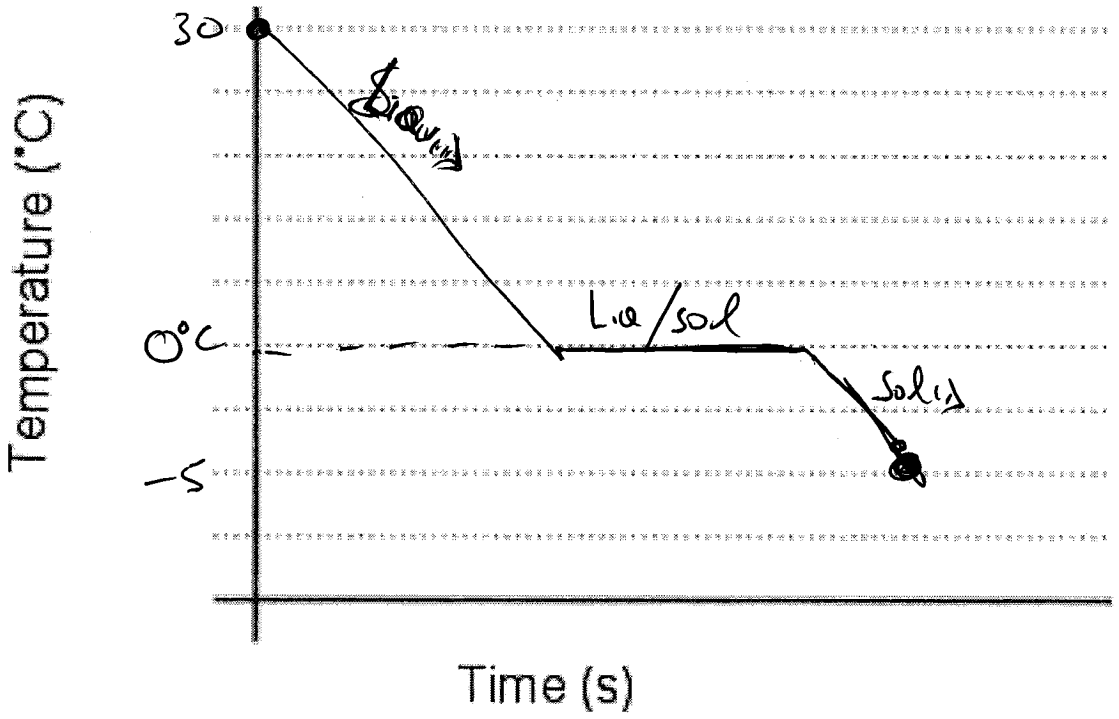
Competency	Grade
3.1 Specific Heat Calcs	
3.2 Energy Bar Chart	
3.3 Temperature Graphs	

Unit 3 Test

3.3 Temperature Graphs

Proficient Questions (75%)

1. A sample of liquid water at 30°C is cooled to – 5°C
   - For this situation sketch the temperature-time graph on the axes below.
   - Be sure to include beginning and ending temperatures as well as the temperature during any phase change.
   - Label which phase(s) is(are) present in each portion of the curve. (ex. Solid, liquid, gas)



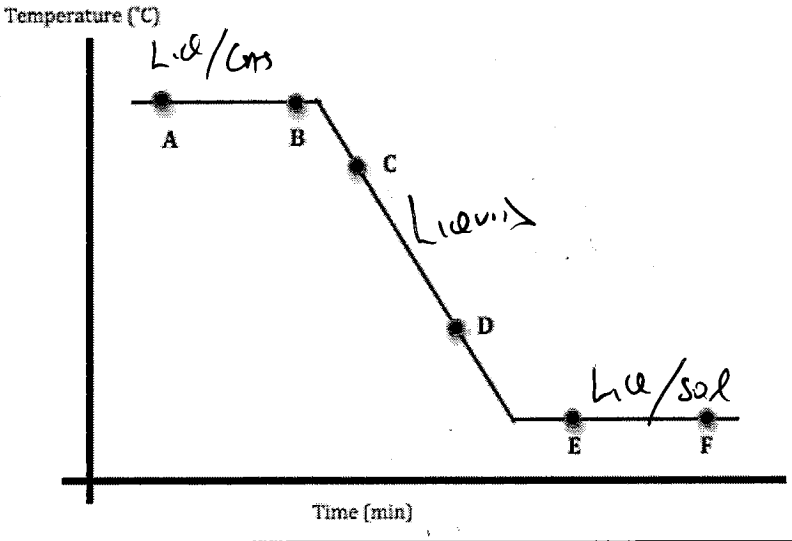
2. The temperature of a substance as it is steadily cooled is shown in the graph below. Show the changes in matter and energy by adding these to each graph:

Between each pair of labeled points

(A-B, C-D…), write or draw

a. the state(s) of matter that are present (ex: Solid, liquid, gas, etc.)

b. the change that is occurring (ex: temperature increasing, melting, condensing, etc.

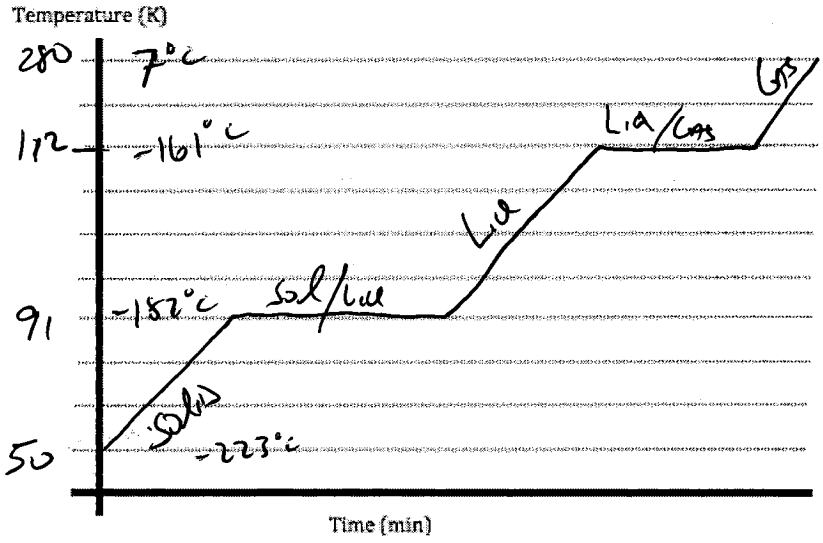


Interval	Description	
A - B	State(s) Present	LIQUID / GAS
	Change	CONDENSING
C - D	State(s) Present	LIQUID
	Change	COOLING
E - F	State(s) Present	LIQUID / SOLID
	Change	FREEZING

Advanced Questions (100%)

3. Methane at 50 K is converted all the way to methane vapor at 280 K.
   a. Sketch the heating curve for this process.
   b. Label all of the states present in each section of the curve.

   (Melting point of methane = 91 K; Boiling point of methane = 112 K)

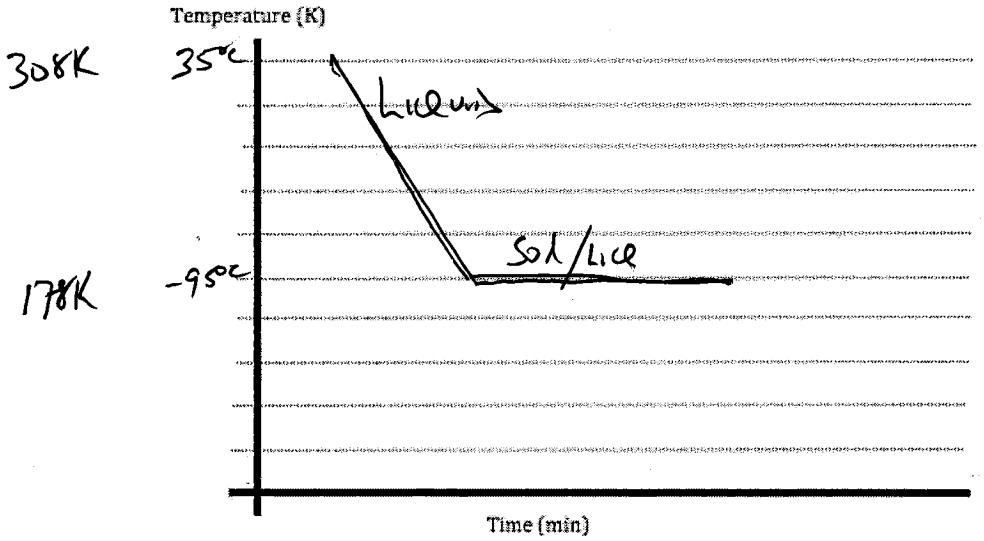


308K

4. Liquid acetone at 35°C is cooled until it forms a solid at its freezing point.
   a. Sketch the cooling curve for this process.
   b. Label all of the states present in each section of the curve.

   (Melting point of acetone = 178 K; Boiling point of acetone = 329 K)

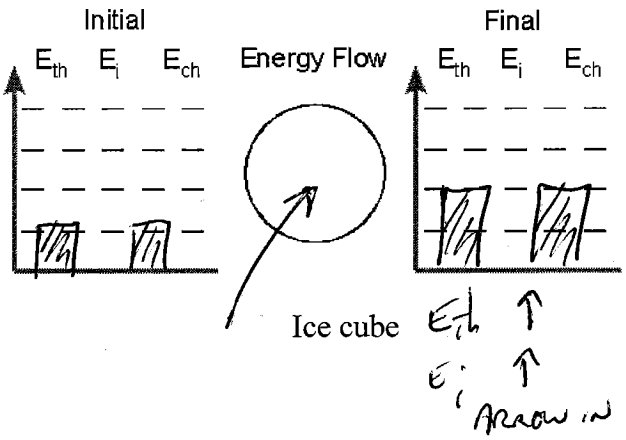
-95°C 56°C

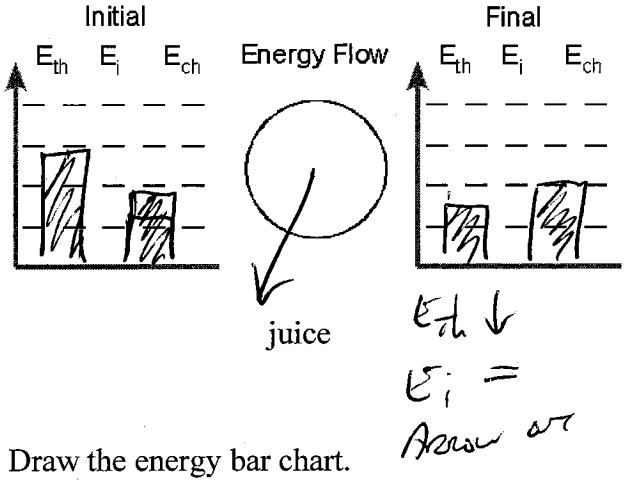


3.2 Energy Bar Charts

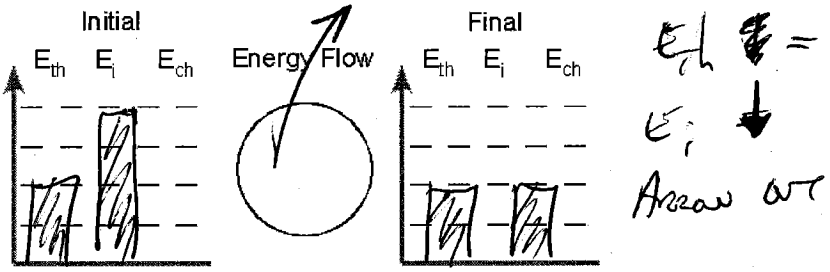
Proficient Questions (75%)

1. An ice cube at -5°C melts in a cup of juice at 25°C. Draw the energy diagram for both the ice cube and the juice.

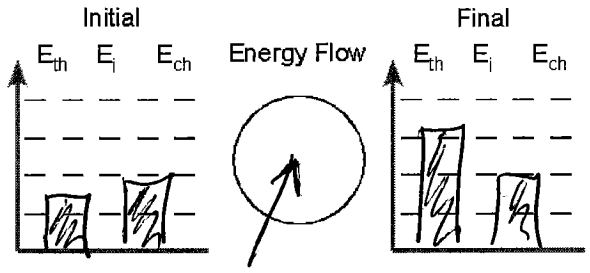




2. Water vapor at 100°C condenses to liquid at 100°C. Draw the energy bar chart.



3. A pan of water (25°C) is heated to boiling and some of the water is boiled away. Do separate energy bar charts for each stage of the process. Below each graph label the process that is taking place.

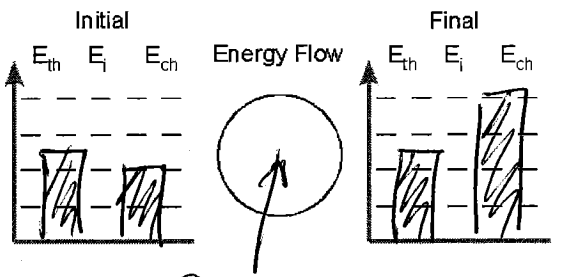


Process: HEAT

E_{th} ↑

E_i =

Arrow = IN



Process: Boil

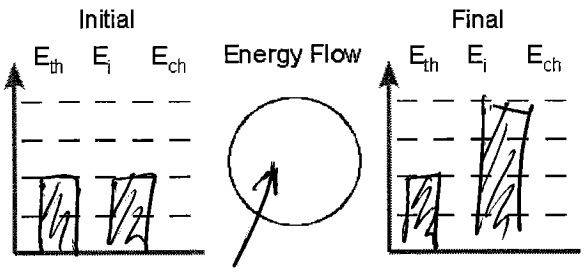
E_{th} =

E_i ↑

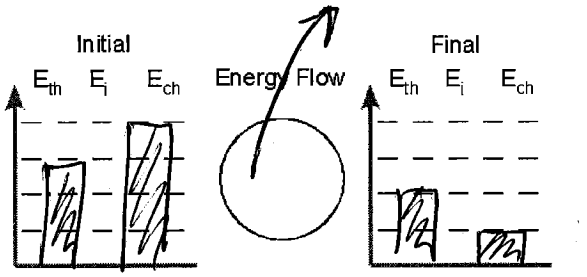
Arrow in

Advanced Questions (100%)

4. To make those shiny, silvery snack bags manufacturers heat liquid aluminum until it evaporates. The aluminum gas is then sprayed onto the bag forming a very thin solid-metal layer. Do separate energy bar charts for each stage of the process. Below each graph label the process that is taking place.

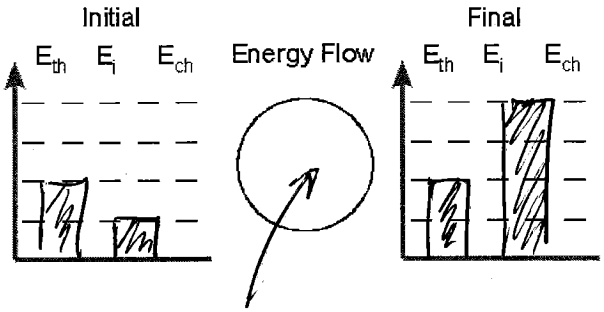


Process: EVAP E_{th} ? E_i ↑ Arrow IN



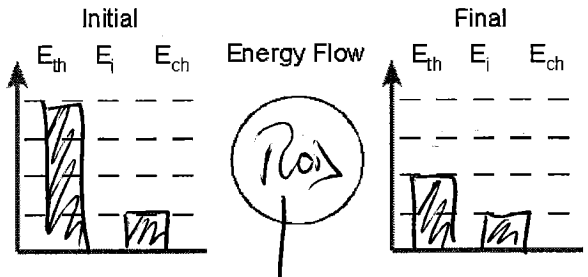
Process: Deposition E_{th} ? E_i ↓ Arrow OUT

5. Solid carbon dioxide at 195 K sublimates to form gaseous carbon dioxide at the same temperature.

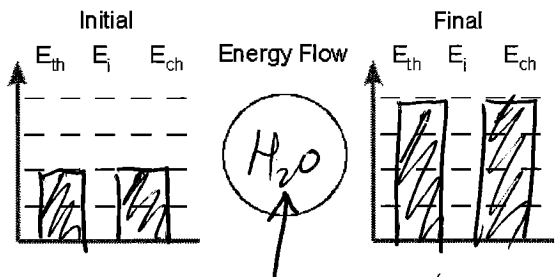


E_{th} =
E_i ↑
Arrow IN

6. A student heats a metal rod up until it is glowing red. The student then dunks that hot metal rod into a container of water at room temperature. The water almost immediately starts to boil. Draw separate bar charts for the metal rod and the water during this process.



E_{th} ↓
E_i =
Arrow OUT



E_{th} ↑
E_i
Arrow IN

3.1 Specific Heat Calculations

Proficient Questions (75%)

Be sure to show work, round to the proper number of sig figs and label quantities.

Energy	Constants (H_2O)	
334 J/g	Heat of fusion (melting or freezing) H_f	$\mathbf{E = m\ C\ (T_{end} - T_{begin})}$
2260 J/g	Heat of vaporization (evaporating or condensing) H_v	$\mathbf{E = m\ H}$
2.0 J/g°C	Heat capacity (c) of water vapor	
4.18 J/g°C	Heat capacity (c) of liquid water	
2.1 J/g°C	Heat capacity (c) of solid water	

1. Water (450g) at 25°C is heated to 95°C. How much energy did this require?

$(450)(4.18)(70) = 131670$

130 KJ

2. **Water vapor** (175g) is cooled from 100.0°C to 37°C. How much energy was released?

$(175)(2260) = 395,500$

$(175)(4.18)(63) = 46,084$

441584

440 KJ

3. Water sits in a pot on a stove. A student takes readings and finds that there are 250 mL of water in the pot, and that the current temperature is 25.0°C. The stove is turned on and the water absorbs 145 kJ of energy from the stove. How much of the original water is boiled away?

$(250)(4.18)(75) = 78375$

$145,000 - 78375 = 66625$

$66625 = m(2260)$

$m = 29.4$

29g

Advanced Questions (100%)

4. A student observes a cup and finds that it has 42g of ice and 58g of liquid water thoroughly mixed inside it. Four hours later the student returns to find the ice melted and the liquid inside the cup at a temperature of 19°C. How much energy did the water absorb from the surroundings during those four hours?

$(42)(334) = 14028$

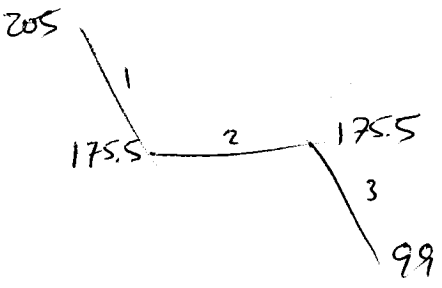
$(100)(4.18)(19) = 7942$

21970

22 KJ

5. A container of 65 g of methanol is cooled from 205 K down to 99 K. How much heat is released in the process?

Heats of Physical Change						
Substance	C_{sol} (J/g°C)	C_{Liq} (J/g°C)	Freezing point (K)	ΔH_{fus} (J/g)	Boiling point (K)	ΔH_{vap} (J/g)
Methanol	1.95	2.50	175.5	99	337.2	1103



$(65)(2.5)(29.5) = 4794$

$(65)(99) = 6435$

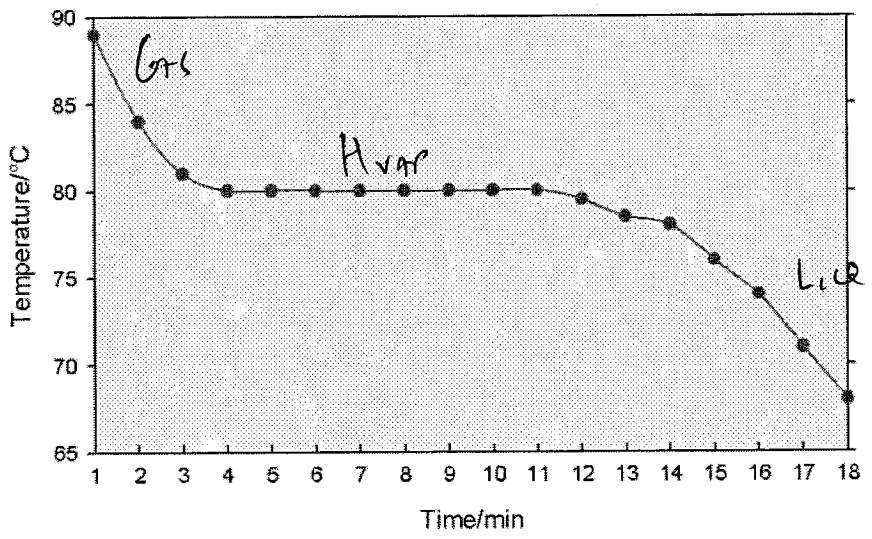
$(65)(1.95)(76.5) = 9696$

20925

21 KJ

6. The following graph shows 45 g of an unknown substance being cooled from a gas to a liquid. Calculate the total energy released by the substance during the time period shown on the graph.

1.52 J/g°C	Heat capacity (c) of solid unknown		127 J/g	Heat of Fusion (H_{fus})
1.73 J/g°C	Heat capacity (c) of liquid unknown		395 J/g	Heat of Vaporization (H_{vap})
1.05 J/g°C	Heat capacity (c) of gas unknown			



$(45)(1.05)(80-85) = 425$

$(45)(395) = 17775$

$(45)(1.73)(67-80) = 1012$

19212

19KJ